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新疆玛纳斯古近纪一新的鲤科鱼类[1)]

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摘要:记述了新疆玛纳斯古近纪安集海河组发现的鲤科(Cyprinidae)一新属、种——刘氏天山鱼(*Tianshanicus liui* gen. et sp. nov.)。新属具有臀鳍分叉鳍条多于7根、体长形稍侧扁、口端位、下咽齿近锥形而齿尖前后略侧扁、背鳍和臀鳍均无硬棘、背鳍起点略在腹鳍起点之后以及尾鳍深分叉等特征,表明它应属于雅罗鱼亚科(Leuciscinae *sensu* Cavender & Coburn, 1992)。然而,它又具有额骨前宽后窄、顶骨长方形、膜质蝶耳骨很大、齿骨冠状突较低、鳃盖骨近长方形等特征而有别于本亚科中其他属。值得注意的是,这些特征却见诸于现生的胭脂鱼类 *Myxocyprinus* 中,这将对研究雅罗鱼类的起源很有意义。根据鱼化石和哺乳化石的证据,认为含鱼层的时代为晚始新世。

关键词:新疆准噶尔盆地,晚始新世,鲤科,雅罗鱼亚科

中图法分类号:Q915.862 **文献标识码**:A **文章编号**:1000-3118(2011)02-0141-14

本文所记述的鲤形类鱼化石是由中国科学院古脊椎动物与古人类研究所新疆古生物考察队苏德造和童永生等同事采集自准噶尔盆地南缘玛纳斯古近纪安集海河组(原下绿色组)。现给以系统研究,确定为鲤科中较原始的类群,其现生属种分布于欧洲、东亚及北美,在中国分布较广,据伍献文(1964)和陈宜瑜等(1998)研究报道,除青藏高原外,几遍布于全国各水系。与化石天山鱼相近的新疆雅罗鱼(*Leuciscus merzbacheri*)至今还生存于准噶尔盆地玛纳斯河、乌鲁木齐河和博尔塔拉河等地,为新疆特有的鱼类。至于雅罗鱼属(*Leuciscus*)化石过去主要见于欧洲(德国、捷克、法国和奥地利)、俄罗斯和蒙古等地的渐新世至中新世地层。Obrhelovǎ (1971)建立古雅罗鱼属(*Palaeoleuciscus*)后,她和其他作者如 Gaudant(1994, 1997)等将欧洲雅罗鱼属的所有化石种都归入这个属。雅罗鱼类化石在我国过去大多发现于新近纪地层,如山东省山旺地区中新世地层产有中新雅罗鱼(*Leuciscus miocenicus* Young & Tchang, 1936),周家健(1990)将其改建为中新似雅罗鱼(*Plesioleuciscus miocenicus*)。还有在山西榆社盆地上新世产有张氏雅罗鱼(*Leuciscus tchangi* Liu & Su, 1962)。本文记述的雅罗鱼类化石发现于我国新疆古近纪有属晚始新世或渐新世之争的地层。采集到的标本具有若干与胭脂鱼类相似的原始特征,给以研究,无论在生物地层上还是研究此类鱼起源上都有重要意义。

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1 标本记述

鲤形目 Cypriniformes Bleeker, 1859 (1860)

鲤科 Cyprinidae Bonaparte, 1840

雅罗鱼亚科 Leuciscinae sensu Cavender & Coburn, 1992

天山鱼属(新属) *Tianshanicus* gen. nov.

属型种 刘氏天山鱼(*T. liui* sp. nov.)。

属征 身体小至中等大小的雅罗鱼亚科鱼类,体长形,稍侧扁,尾鳍深叉形,上、下叶末端凸圆。不同于本亚科中其他属的特征如下:额骨前宽后窄,具很扩大的眶后突;顶骨长颇大于宽,长方形;膜质蝶耳骨很大,近弧形;鳃盖骨的上、下部几乎等宽,近长方形;前鳃盖骨的上枝颇长,几乎直立;每侧有一块后匙骨;尾下骨6块,尾上叶占有4块;尾鳍分叉鳍条通常为17根。

刘氏天山鱼(新种) *Tianshanicus liui* sp. nov.

(图1-6; 表1,2)

正型标本 一近乎完整的鱼。中国科学院古脊椎动物与古人类研究所标本编号 IVPP V 12172.1 A-B。

归入标本 不少于15条鱼。V 12172.2, 一较完整的鱼;V 12172.3, 一完整的尾骨骼; V 12172.4, 一较完整的头骨背面;V 12172.5-6, 两块围岩分别埋藏着约6条和4条鱼;V 12172.7-8, 两条不完全的鱼。

特征 见属的特征。头长大,其长甚大于体高;最大体高处紧靠头后;体高与体长之比值为0.22~0.25;头长与体长之比值为0.28~0.35; 脊椎骨总数为38~39个;鳍式:P I, 13~14; V I, 7~8; D III, 8~9; A III, 7~8; C I, 17, I.

产地与层位 新疆准噶尔盆地玛纳斯安集海河组(晚始新世)。

释名 属名由化石产区著名的天山的汉语拼音 Tianshan 和拉丁文词尾-icus(属于)构成;种名赠予已故的古鱼类学家刘宪亭(Liu Xianting)先生。

描述 体形较小的一类雅罗鱼,当前记述标本的体长约为80~148 mm, 以正型标本为最大,全长约达180 mm, 体长148 mm。体长纺锤形,最大体高处紧靠在头后,体长约为体高的4.1~4.4倍,头长的2.8~3.5倍,尾柄长的4.8~5倍,尾柄高约为尾柄长的1/2(图1)。测量见表1。

表1 刘氏天山鱼(新属新种)标本测量

Table 1 Measurements of specimens of *Tianshanicus liui* gen. et sp. nov. (mm)

	V 12172.1	V 12172.2	V 12172.5A_1
体长(Body length)	148	112	83
体高(Body depth)	33	26	20
头长(Head length)	42	32	29
头高(Head depth)	30	29(ca.)	21(ca.)
尾柄长(Caudal peduncle length)	30.5	22	?
尾柄高(Caudal peduncle depth)	15	11	10
背鳍前距(Predorsal distance)	78	60	60
臀鳍前距(Preanal distance)	107	80	54
吻端起点至腹鳍(Distance from tip of snout to pelvic insertion)	72	58	45

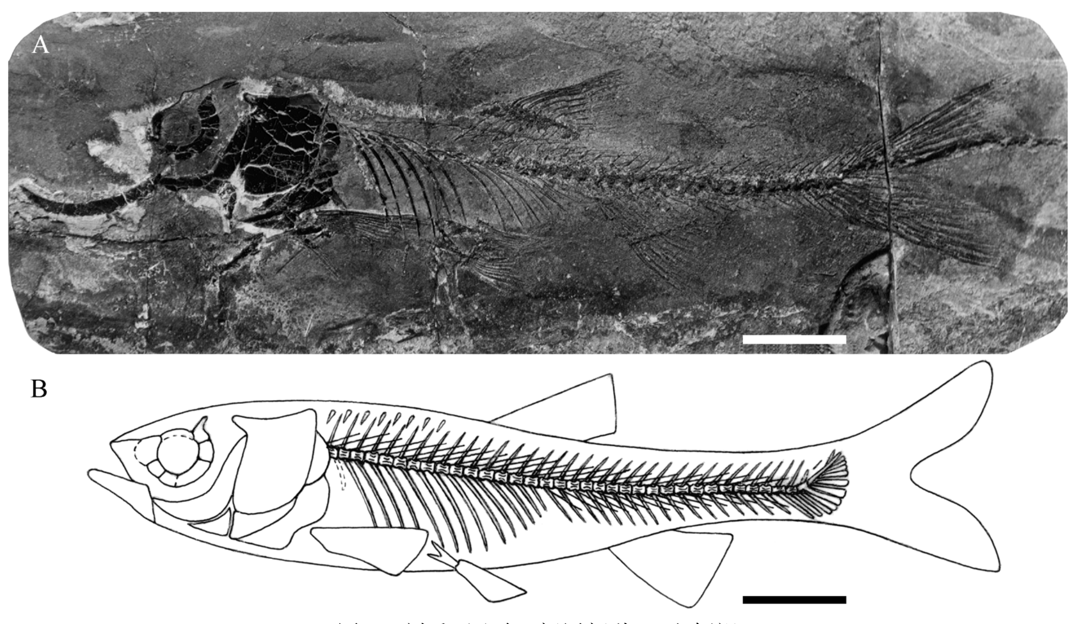


图 1　刘氏天山鱼(新属新种), 左侧视

Fig. 1　*Tianshanicus liui* gen. et sp. nov., left side view, scale bars = 20 mm

A. 正型标本 holotype V 12172.1A, 一近乎完整的鱼 a nearly complete fish;

B. 复原图 tentative reconstruction, 主要根据正型标本 mainly based on holotype

头骨　吻部较尖,头骨侧视略呈三角形。吻部骨片保存不佳,吻骨似乎很小。中筛骨可能较宽大(V 12172.5B_2)。头骨背面骨骼在正型标本上仅保存有部分印模,而在 V 12172.4 上保存较全(图 2, 5C)。一对额骨(Fr)很长大,其长约为顶骨的二倍,前部颇宽,后部变窄,几乎与顶骨等宽,外侧缘中部颇向外扩展,形成颇大而略呈半圆形的眶后突。两额骨之间的内侧缘均较光滑,不像鲤属(*Cyprinus*)那样呈锯齿状相接。一对顶骨(Pa)均略呈长方形,其长约为宽的二倍,内侧缘亦光滑且近乎平直。膜质蝶耳骨(Ds)颇大,不被额骨遮盖,背视略呈弧形,前部显然宽于后部,并向外侧扩展,构成眼眶的后上缘。膜质翼耳骨(Dpt)仅残存前部,前缘和内侧缘分别与膜质蝶耳骨和顶骨相接。上枕骨(Soc)前端中部稍向前突伸,插入两顶骨后部之间,背部颇向后延伸,形成上枕嵴。

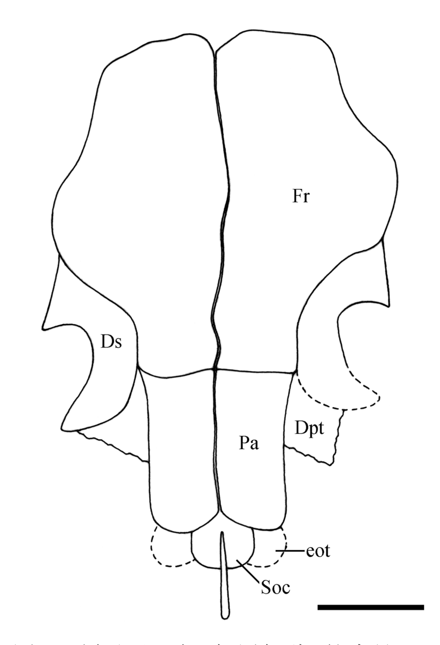


图 2　刘氏天山鱼(新属新种)的头骨顶部(部分复原), 据 V 12172.4

Fig. 2　Skull roof of *Tianshanicus liui* gen. et sp. nov. (partly restored), based on V 12172.4

简字说明见图 3 for abbreviations see Fig. 3;

scale bar = 5 mm

头部侧面骨骼以正型标本保存为最好(图 1A, B; 3)。眼眶较大,位于头侧中部略靠上。

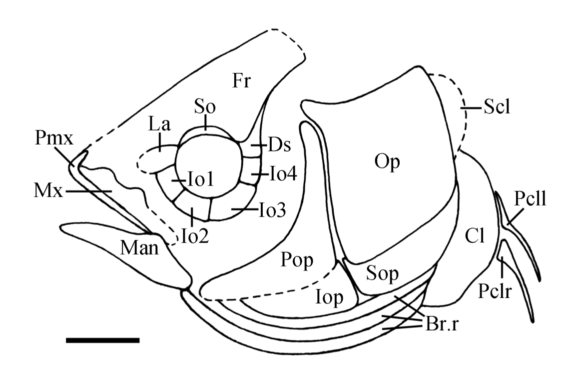


图 3 刘氏天山鱼(新属新种)的头骨和肩带(部分复原), 左侧视,主要据 V 12172.5A

Fig. 3 Skull and pectoral girdle of *Tianshanicus liui* gen. et sp. nov. (partly restored), left side view, mainly based on V 12172.5A, scale bar = 5 mm

缩写 Abbreviations: Br. r. branchiostegal rays 鳃条骨; Cl. cleithrum 匙骨; Dpt. dermopterotic 膜质翼耳骨; Ds. dermosphenotic 膜质蝶耳骨; eot. epiotic 上耳骨; Fr. frontal 额骨; Io_{1-4}. infraorbital 1-4 第一至四眶下骨; Iop. interoperculum 间鳃盖骨; La. lachrymal 泪骨; Man. mandible 下颌骨; Mx. maxilla 上颌骨; Op. operculum 鳃盖骨; Pa. parietal 顶骨; Pcll, Pclr. left and right postcleithra 左、右后匙骨; Pmx. premaxilla 前上颌骨; Pop. preoperculum 前鳃盖骨; Scl. supracleithrum 上匙骨; So. supraorbital 眶上骨; Soc. supraoccipital 上枕骨; Sop. suboperculum 下鳃盖骨

围眶骨环完全,由一块眶上骨、一块泪骨、四块眶下骨及一块膜质蝶耳骨构成。眶上骨(So)略呈弧形,附于额骨外侧缘凹缺内。泪骨(La)较大,前缘似乎凸出,后缘略凹,构成眼眶的前缘。四块眶下骨(Io_{1-4})在大小和形状上各异,第一、二眶下骨均较小,略呈方形;第三眶下骨最为高大,后缘颇长于前缘并向后凸出,构成眼眶的后腹缘;第四眶下骨较高大,高稍大于宽,略呈长方形或四方形。口端位,口裂小并稍向上倾斜。上、下颌在 V 12172.5A_{1-4}中保存较好。前上颌骨(Pmx)具有短的升突和发达的侧枝,构成整个上颌口缘。上颌骨(Mx)颇强壮,被排斥于口裂之上,向后约伸达眼眶中部之下,其背缘具两个大的突起,腹缘近乎平直。下颌骨(Man)(含齿骨、隅骨和关节骨)很硕壮,前端尖突,从前向后逐渐加高,具较低的冠状突。

鳃盖骨系统很发达(图 1, 3), 鳃盖骨(Op)很大,呈不规则长方形,高约为宽的 1.3 ~ 1.5 倍,上部几与下部等宽,下缘约呈 20°倾斜,背缘微凹,前缘近乎平直。前背关节突很强壮,向前上方突伸,其基部内侧具一大的球形关节窝,与舌颌骨头相接。后背突

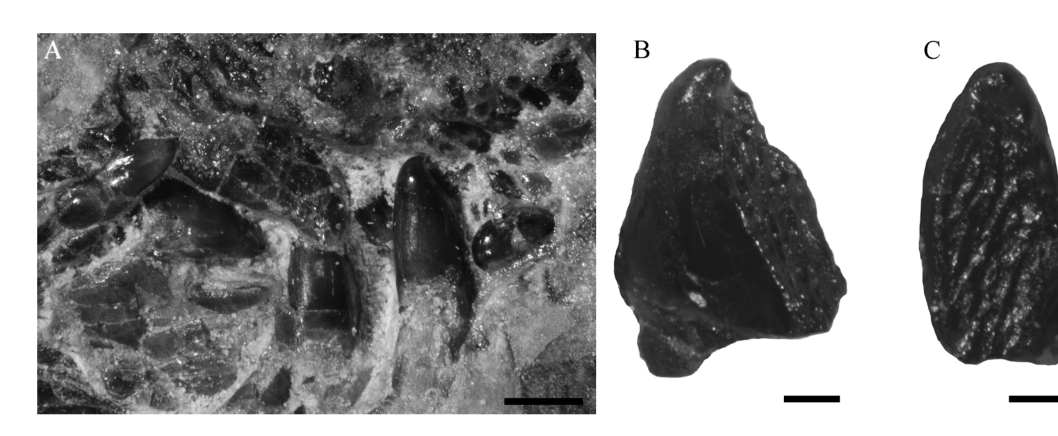


图 4 刘氏天山鱼(新属新种)的咽齿

Fig. 4 Pharyngeal teeth of *Tianshanicus liui* gen. et sp. nov.

A. V 12172.6 上的咽齿 pharyngeal teeth from V 12172.6, scale bar = 0.5 mm; B, C. V 12172.5 上的单个咽齿 single tooth from V 12172.5, scale bars = 0.1 mm, B. 示齿冠、齿尖和咀嚼面 showing crown, tip, and grinding surface, C. 示咀嚼面及其上斜脊 showing grinding surface and oblique ridges on the surface

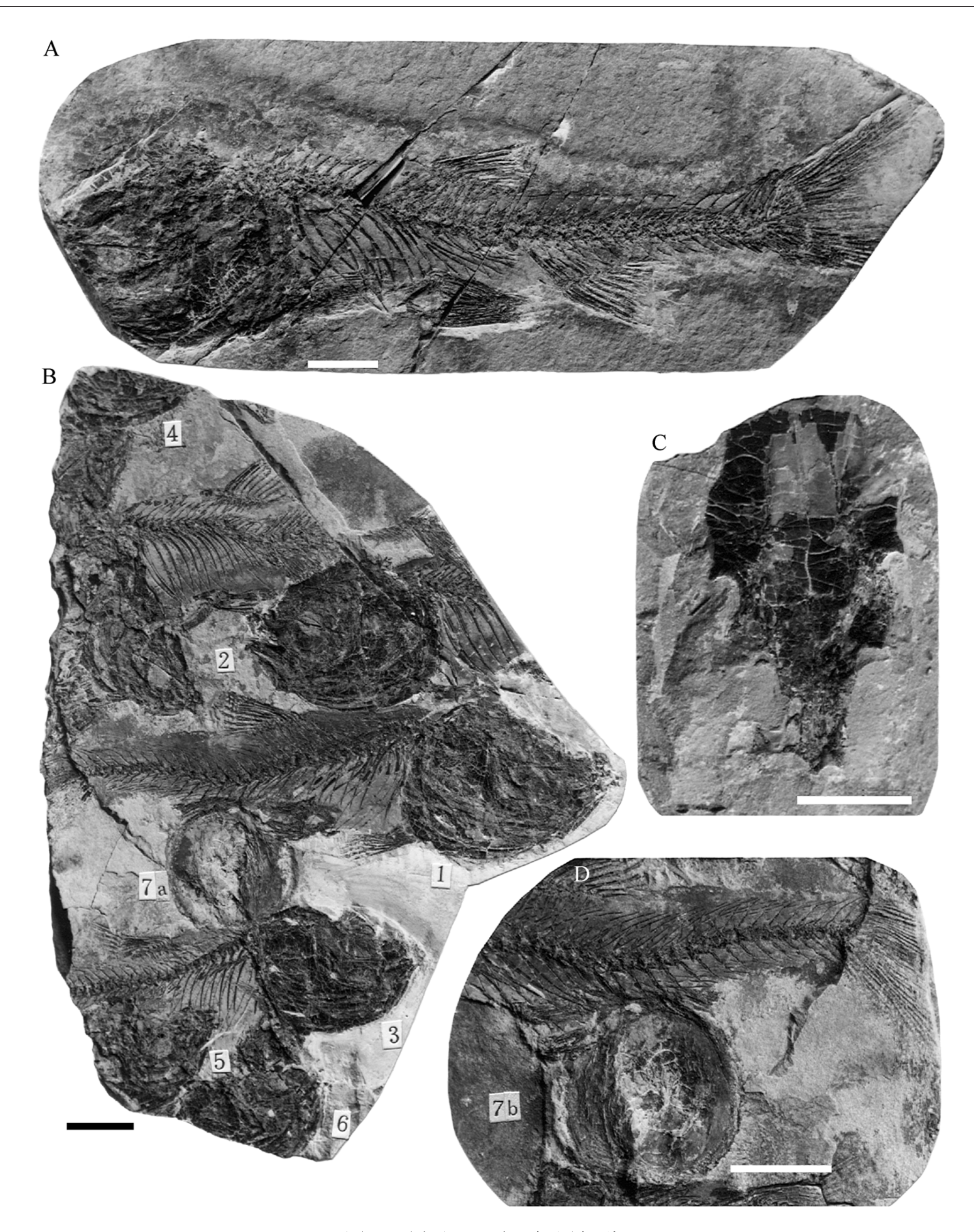


图 5　刘氏天山鱼(新属新种)

Fig. 5　*Tianshanicus liui* gen. et sp. nov. ,scale bars = 10 mm

A. 一近乎完整的鱼(V 12172. 2), 示体形和鳍 a nearly complete fish (V 12172. 2), showing body form and fins; B. 一群鱼埋藏在一块围岩上(V 12172. 5A), 约有 9 个个体,其中一个(7a)为骨舌鱼科的一个鳞片 a group of fish (V 12172. 5A)(about 9 individuals) embedded in one piece of rock, one of which (7a) assigned to a scale of the Osteoglossidae(?); C. 一近乎完整的头骨顶部(V 12172. 4), 示骨片形状(详见图 2) a nearly complete skull roof (V 12172. 4), showing shape of bones (see Fig. 2); D. V 12172. 5A反面的一部分,示骨舌鱼科一鳞片的网状结构 counterpart of an enlarged part of V 12172. 5A, showing reticulate structure of an osteoglossid(?) scale

不显著，但在不同个体中有所变化。下鳃盖骨（Sop）甚小于鳃盖骨，略呈长三角形，具有短的前背突。前鳃盖骨（Pop）呈镰刀形，垂直枝长于水平枝，向上几伸达鳃盖骨前背关节突基部的球窝关节处，与水平枝相交所成的内夹角大于直角。间鳃盖骨（Iop）略呈长三角形，后背角显著突起。鳃条骨（Br. r）较强壮，每侧通常为三条。

咽齿（图4A–C） 在V 12172.2A，V 12172.5B，V 12172.6和V 12172.7等标本上均能见到咽喉齿。V 12172.6上的咽齿较多，大小不等，因未见与其相连的咽骨，无法推测咽齿行数。咽齿大多呈略扁的圆柱型，顶端具一略弯曲的尖（图4A），V 12172.5B上的单个咽齿显示，咀嚼面略窄长，上有斜条状脊（图4B，C）。

躯部骨骼 脊椎约有35~36个（魏氏器除外），其中躯椎14，尾椎21~22个（图1，5A，B，D）。椎体长略大于高，中部显著收缩，侧面具有纵嵴和纵坑。魏氏器仅保存有印痕（V 12172.5A）。第四脊椎生有强大的椎体横突。肋骨约有14对，前6对长而粗壮，几乎伸达腹缘，其后依次变细。所有髓棘（除脊柱前端的不明外）和脉棘均颇细长，前者几乎向后上方延伸到背缘之下，后者几乎向后下方延伸到尾柄腹缘之上。肌间骨（上髓弓小骨和脉弓小骨）很发达，数目多而细长。除脊椎前端部分外，几乎所有脊椎的髓弓基部均生有上髓弓小骨。它们均向后上方延伸并与髓棘相交。脉弓小骨生自几乎所有尾椎脉弓的基部，向后下方延伸并与其后的脉棘相交。这些特点颇相似于 *Ecocarpia ningmingensis*（Chen et al.，2005），*Palaeorutilus*（Gaudant，2002）和 *Amyzon*（Wilson，1977）。此外，在头后和背鳍之间的背缘下面具有一列（约6~7块）上神经骨，均略呈长三角形，倒插在每两髓棘之间。

尾骨骼 尾骨结构（图5）属于鲤科类型：第一尾前椎（pu_1）和第一、二末端尾椎（u_1和u_2）愈合为一个复合锥体（compound centrum），尾杆骨（pleurostyle）又与此复合椎体愈合并伸向后上方；尾杆骨长条形（V 12172.6），尾神经骨（un）一个，附于尾杆骨的后背部；尾下骨6块（$h_{1\text{-}6}$），第一尾下骨（h_1）和副尾下骨（ph）近端愈合，与复合椎体连接；第二尾下骨（h_2）近端与复合椎体愈合；第三至六尾下骨（$h_{3\text{-}6}$）近端与尾杆骨连接；第一尾前椎（pu_1）上有一雏形的髓棘（ns）；尾神经骨上面有一根游离的尾上骨（ep）；第二至五尾前椎（$pu_{2\text{-}5}$）的髓棘和脉棘（hs）均颇长。

肩带与胸鳍 肩带在正型标本（V 12172.1A）中保存较完全（图1，3），匙骨（Cl）很强壮，通常呈汤匙形，其下部颇宽大于上部，上部向上逐渐变窄，顶端为上匙骨所覆盖，下部向前弯伸，后腹缘拐弯处具一凹口。每侧具有一根后匙骨（Pcl），附着于匙骨中、下部的内侧面，不呈"S"形，而是前部扩大，后部向后逐渐变细而稍弯，略呈棘状并伸向腹缘，颇相似于 *Catostomus*（Weisel，1960，fig. 1）和 *Cyprinus*（秉志，1960，fig. 12），也与Wilson（1977：30）对 *Amyzon* 所描述的形态基本一致。上匙骨（Scl）在V 12172.5A1中尚可辨认，为一窄而高的长条形骨。肩胛骨（scapula）居匙骨后腹缘凹口处，呈不规则的多角形，中部具一大孔。乌喙骨（coracoid）很长大，前部低窄，向后逐渐增高，略呈长三角形，后端邻接辐射骨，前端几伸达匙骨的下枝中部之下。在胸鳍基部有两列鳍基骨，近端一列（约4块）为辐射骨（radia），远端一列（13~14根）为支鳍骨（pterygiophores），支持胸鳍。胸鳍很长大，前面最长的鳍条向后约伸达至腹鳍距离的2/3，鳍条为I，13~14根，前面的那根不分叉者特别粗壮。

腹鳍很小,几居胸鳍和臀鳍间距的中点,具有鳍条 I, 7 ~8 根,前面的那根不分叉者较粗壮,由一块大而呈叉形的无名骨(腹鳍骨)所支持。

背鳍短,顶端并不微凹,鳍条为 III,8 ~9 根,其起点对着或略后于腹鳍的起点,几乎与第 13 至 14 脊椎相对,由一列(9 ~10 根)略呈倒置长三角形的支鳍骨所支持,第一根下部特别扩大,呈斜塔形。

臀鳍亦短,离尾鳍远,鳍条为 III,7 ~8 根,以最前一根分叉鳍条为最长,其余依次减短,约由 10 根长三角形的支鳍骨所支持,最前一根较扩大。

尾鳍深分叉,尾叶后缘略凸圆,具有主鳍条 I, 17, I 根。尾上叶的主鳍条与第三至六尾下骨($h_{3\text{-}6}$)相连接,其前的多根短小鳍条与尾神经骨(un)、尾上骨(ep)及第二至四尾前椎的髓棘相接。尾下叶的主鳍条与副尾下骨(ph)、第一至二尾下骨($h_{1\text{-}2}$)及第二尾前椎的脉棘相连接,其前的多根短小鳍条则与第二至四尾前椎的脉棘相连接。

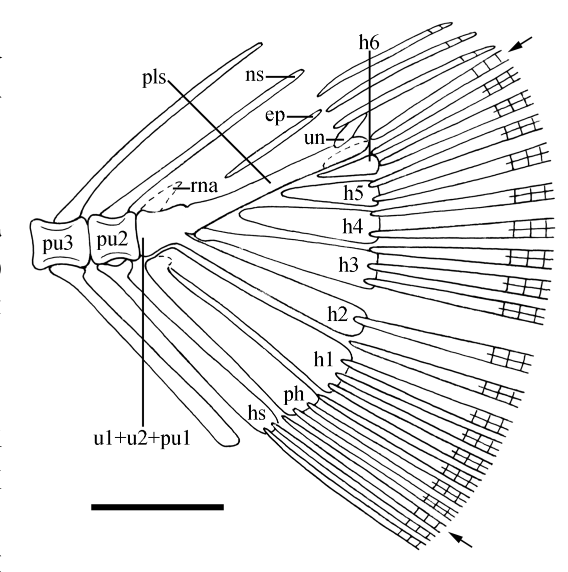


图 6　刘氏天山鱼(新属新种)尾骨骼复原,据正型标本(V 12172. 1A)

Fig. 6　A schematic reconstruction of caudal skeleton of *Tianshanicus liui* gen. et sp. nov., based on holotype (V 12172. 1 A), scale bar = 5 mm

箭头示尾鳍最上和最下的主鳍条(不分叉) arrows indicate the upper- and lowermost principal fin rays

缩写 Abbreviations: ep. epural 尾上骨; $h_{1\text{-}6}$. hypurals 1-6 第一至六尾下骨; hs. haemal spine 脉棘; ns. neural spine 髓棘; ph. parhypural 副尾下骨; pls. pleurostyle 尾杆骨; $pu_{1\text{-}3}$. preural centra 1-3 第一至三尾前椎; rna. rudimentary neural arch 雏形的髓弓; u_1, u_2. ural centra 1-2 第一、第二末端尾椎; un. uroneural 尾神经骨

鳞片　仅在 V 12172. 7 的尾柄上隐约可见其多个印痕,无疑属于圆鳞,生长线细密,辐射沟观察不清。

比较　以上所描述的天山鱼(新属) *Tianshanicus* gen. nov. 的一般形态特征,如体长形,稍侧扁,口端位略上,眼侧上位,第三围眶骨(io_3)特大,背鳍无硬棘,具分叉鳍条 8 ~9 根,臀鳍也无硬棘,具分叉鳍条 7 ~8 根,尾鳍深分叉,上、下叶几等长,以及下咽齿近略侧扁的锥形等,与 *Leuciscus* (Sychevskaya, 1989), *Palaeoleuciscus*, *Palaeorutilus* (Obrhelovǎ, 1971; Gaudant, 1994, 1997)和 *Plesioleuciscus* (周家健,1990)相似。*Leuciscus* 为现生属,如新疆雅罗鱼(*Leuciscus merzbacheri*)至今还生存于我国新疆博尔塔拉河、玛纳斯河及乌鲁木齐河等地,为新疆特有的鱼类(陈宜瑜,1998)。天山鱼在大小和尾鳍上、下叶末端凸圆等特点上,与新疆雅罗鱼相似,但后者体形较高,头后背缘稍隆起,最大体高处在背鳍之前,背鳍分叉鳍条较少(7 根), 臀鳍(8 ~9 根)和胸鳍(16 根)分叉鳍条较多, 鳃盖骨的上部窄于下部,略呈梯形。根据以上诸点就可与天山鱼区分。化石属 *Palaeoleuciscus* 产于欧洲(主要在捷克和德国)渐新世至中新世地层(Obrhelovǎ, 1971; Gaudant, 1994, 1997), 它不同于天山鱼在于:背缘略隆起,最大体高处在背腹鳍之间,头不长大,背鳍的分叉鳍条较少(7 ~8 根), 臀鳍分叉鳍条较多(8 ~11 根), 头部和尾部骨骼大不同于

天山鱼(见表2)。*Palaeorutilus* 产于德国渐新世地层,体形延长,头特别长大,最大体高处在头后,背鳍和臀鳍分叉鳍条均为7~8根,胸鳍分叉鳍条13~15根,腹鳍分叉鳍条8或9根,头骨顶部较宽,上颌骨口缘近乎平直以及上髓弓小骨和脉弓小骨很发达等(Gaudant, 1988)许多方面与新属天山鱼很相似,但其尾鳍上、下叶末端尖锐,头部和尾部骨骼及咽齿形状与天山鱼有很大的区别(见表2)。*Plesioleuciscus* 产于我国山东省山旺盆地中中新世地层,体小,全长35~86 mm,个别达到132 mm(周家健,1990), 与天山鱼相似,臀鳍分叉鳍条8根,腹鳍分叉鳍条8~9根及胸鳍分叉鳍条13~15根等三鳍的鳍条数目也与天山鱼相应鳍鳍条数目基本上相等,但背鳍分叉鳍条较少(7根), 头不长大,最大体高处在背腹鳍之间,头部和尾部骨骼及脊椎骨数目等显然有别于天山鱼(见表2)。

以上的比较表明,天山鱼既不同于现生雅罗鱼类,又与化石属有显著的区别,应代表一新属、新种——刘氏天山鱼 *Tianshanicus liui* gen. et sp. nov.。

表2 天山鱼(新属)与相近化石的部分结构对比简表

Table 2 Comparison of structures of *Tianshanicus* with closely related fossil forms

	Tianshanicus gen. nov.	*Palaeoleuciscus* Obrhelovǎ, 1971	*Palaeorutilus* Gaudant, 1988	*Plesioleuciscus* Zhou, 1990
额骨 Frontals	前宽后窄,眶后突很大	前窄后宽,眶后突小	前窄后宽,眶后突较小	前窄后宽,眶后突小
顶骨 Parietals	较长,长方形	短,近方形	短,近方形	短,近方形
蝶耳骨 Sphenotics	很大,近弧形	很小	很小,近方形	很小,近方形
眶下骨系列 Infraorbitals	强壮,较宽	较窄	狭窄	微弱,很窄
上颌骨 Maxilla	口缘平直	口缘略拱曲	口缘近平直	口缘近平直
齿骨的冠状突 Coronoid process	较低	很高	很高	较窄高
鳃盖骨 Operculum	上、下部几等宽	上部窄于下部	上部窄于下部	上部窄于下部
前鳃盖骨 Preoperculum	上枝长于下枝,近乎直立	上枝短于下枝,向前倾斜	上枝短于下枝,向前倾斜	上枝几与下枝等长,向前倾斜
脊椎骨总数 Vertebral number	38~39	32~35	36~38(39)	34
尾下骨数目 Hypural number	6, 尾上叶占4个	5, 尾上叶占3个	5, 尾上叶占3个	4个
尾鳍分叉鳍条 Caudal branched rays	通常17根	通常17根	通常17根	通常17根

2 讨论

2.1 关于天山鱼(新属)的系统位置

综上所述,天山鱼(新属)因其脊柱前端具有魏氏器(Weberian apparatus), 鳍无棘,腹鳍腹位,背鳍单一,几乎对着腹鳍,偶鳍不分叉鳍条仅有1根,口缘无牙齿,下咽骨具有数量不

是很多的、典型的鲤科咽齿以及前上颌骨具发达的侧枝,将上颌骨排斥于口裂之上等特征表明,它应属于鲤科(Cyprinidae)。另外,根据天山鱼的臀鳍具7根以上的分叉鳍条,体长形而稍侧扁,口端位,眼侧上位,第三围眶骨(Io_3)特大,背鳍和臀鳍均无硬棘及尾鳍深分叉等特征,可将其置于雅罗鱼亚科(Leuciscinae)。然而,在骨骼系统上,天山鱼与此亚科鱼类有所区别,如在头骨顶部,天山鱼的额骨有扩大的眶后突和狭窄的后部(与顶骨等宽),既相似于雅罗鱼亚科鱼类如高体雅罗鱼 *Leuciscus idus*(孟庆闻, 1985, fig. 4A),又与胭脂鱼科的中国胭脂鱼 *Myxocyprinus asiaticus*(罗云林、伍献文,1979, fig. 1)相似,但其他雅罗鱼类的额骨前部并不如天山鱼和胭脂鱼类那样扩大。天山鱼具有长方形的顶骨,颇相似于中国胭脂鱼,但不同于雅罗鱼亚科鱼类如 *Leuciscus*, *Palaeoleuciscus*, *Palaeorutilus* 和 *Plesioleuciscus* 等属。天山鱼具有大而呈弧形的膜质蝶耳骨,此与高体雅罗鱼 *Leuciscus idus*(孟庆闻, 1985, fig. 4B)有些相似,但更相似于胭脂鱼科的 *Catostomus*(Weisel, 1960, fig. 3), *Carpiodes*(Gregory, 1933, fig. 76B)和 *Myxocyprinus asiaticus*(罗云林,伍献文,1979, fig. 1)等属。在尾骨骼方面,天山鱼的尾下骨有6块,尾鳍分叉鳍条通常有17根。

根据以上的分析,天山鱼某些方面虽与胭脂鱼科鱼类有所相似,但它具有与鲤科鱼类相似的若干共近裔性状(synapomorphies),如前上颌骨具有很发达的侧枝,将上颌骨排斥于口裂之上,以及下咽骨具有为数不很多的咽齿等。根据近裔性状为分类的主要依据,天山鱼应属于鲤科,同时它还保留着与胭脂鱼科鱼类相似的若干近祖性状(plesiomorphies)。这表明天山鱼可能与胭脂鱼科鱼类有系统发育上的关系。

2.2 关于含鱼层安集海河组的时代

前面已提到,刘氏天山鱼(*Tianshanicus liui* gen. et sp. nov.)产于准噶尔盆地南缘古近纪安集海河组。该组主要为一套湖相沉积,多为灰绿色泥岩,常夹有泥灰岩和薄层砂岩。其地质时代还有争论,据李云通(1984)对中国第三纪地层的研究报道,研究介形类者蒋显庭认为它属于渐新世,研究瓣鳃类者黄宝玉和魏景明认为它属于渐新世至中新世而倾向于渐新世。而李云通(1984)根据古生物地层的证据,将其时代划为晚始新世至渐新世。现根据鱼化石的研究,其时代似应属于晚始新世,其依据如下:1) 天山鱼与德国渐新世的 *Palaeorutilus* 最接近,但又与之有属之间的区别,并具有若干较原始的性状,故天山鱼的时代似应早于渐新世;2) 与刘氏天山鱼伴生的还有属于骨舌鱼科(Osteoglossidae)的鳞片(V 12172. $5AB_{7a\text{-}b}$),它为较厚大的圆鳞,具有明显的网状结构,颇相似于印尼中苏门答腊晚始新世的 *Musperia*(Sanders, 1934)和中国四川芦山晚始新世的 *Sinoglossus*(苏德造,1986); 3) 在本盆地南缘的塔西河、南安集海和奎屯河等地的同一层位(安集海河组)还产有属于弓鳍鱼科(Amiidae)的弓鳍鱼(*Amia* sp.)和鲶形目(Siluriformes)的 *Siluridarum* sp.(彭希龄,1975)。弓鳍鱼属虽还生存于北美洲淡水水域中,但其化石常见于北美和欧亚大陆新生代,特别是古近纪地层,如美国的中始新世绿河组(Grande, 1980)、东哈萨克斯坦的始新世至渐新世(Sychevskaya, 1986)、中国内蒙古沙拉木伦(Hussakof, 1932)、吉林桦甸(Chang et al., 2001; Liu and Chang, 2009)、渤海湾沿岸(张弥曼等,1985; 张弥曼、陈宜瑜,2000)和湖南(张弥曼等,2010)等地的始新世地层。鲶类化石也常见于这些地区的同一地层。基于上述鱼群的性质及其在地史上分布的情况,并考虑到本组中还产有较

原始的沟齿兽(*Bothriodon* sp.), 经周明镇(1958)研究,将其时代定为晚始新世,故含鱼层的时代定为晚始新世为宜。这个结论还可以从吐鲁番盆地晚始新世连坎组产有与安集海河组同样的沟齿兽(郑家坚,1978)得到进一步的证明。此外,在玛纳斯河上游和清水河等地本组中还产有属于晚始新世的玛纳斯准噶尔鳄(*Dzungarisuchus manasensis*)(董枝明,1974), 这亦可为之佐证。

A NEW CYPRINID FISH FROM PALEOGENE OF NORTHERN XINJIANG, CHINA

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Key words Junggar Basin, Xinjiang; late Eocene; Cyprinidae, Leuciscinae

Summary

The fossil cypriniform fishes described here were collected from the Anjihaihe Formation (Paleogene) in the Manas County in northern Xinjiang, and referred to a new genus and species, *Tianshanicus liui*, of the family Cyprinidae. This new genus shows typical characters of the subfamily Leuciscinae, and is of great interest for studying the origin of the subfamily Leuciscinae. According to the nature of the fish-fauna and mammal fossils, the age of the fish-bearing beds is considered as late Eocene.

Order Cypriniformes Bleeker, 1859 (1860)
Family Cyprinidae Bonaparte, 1840
Subfamily Leuciscinae *sensu* Cavender & Coburn, 1992
Genus *Tianshanicus* gen. nov.
Type Species *Tianshanicus liui* sp. nov.

Generic diagnosis Body small to moderate size, elongate-fusiform, differing from other genera in the subfamily Leuciscinae in the following characters: frontal broad anteriorly and narrow posteriorly, with greatly expanded postorbital process; parietal long, rectangular; dermosphenotic very large, arched; upper part of operculum as wide as lower one, roughly rectangular; dentary with low coronoid process; upper limb of preoperculum long, almost vertical; six hypurals, four of them upper hypurals; caudal fin with 19 principal rays and rounded upper and lower lobs.

Tianshanicus liui sp. nov.

(Figs. 1-6)

Holotype A nearly complete fish, Cat. No. IVPP V 12172.1A-B.

Referred specimens Specimens of about 15 individuals from the same locality and horizon as the holotype: V 12172.2, a nearly complete fish; V 12172.3, a well-preserved caudal skeleton; V 12172.4, a nearly complete skull roof; V 12172.5-6, two groups of fish remains embedded in two pieces of rocks; V 12172.7-8, two incomplete fishes.

Diagnosis Head large, its length much greater than depth of body; maximum depth of body just behind head, body depth/standard length ratio 0.22 to 0.25; total number of vertebrae 38 ~ 39; D III, 8 ~ 9; A III, 7 ~ 8; P I, 13 ~ 14; V I, 7 ~ 8; C I, 17, I.

Locality and horizon Manas Mountain, Manas County, Junggar Basin, northern Xinjiang; Anjihaihe Formation, late Eocene.

Description All specimens have standard length between 80 and 148 mm. The largest

specimen is the holotype, attaining to a total length of about 180 mm. The maximum depth of the body is about 1/5.4 of the total length, 1/4.4 of the standard length. The length of the head with opercular apparatus is much greater than maximum depth of the body. The depth of the caudal peduncle is about 1/2.2 of its length.

The skull is roughly triangular from its side view. The skull roof (Fig. 2) is shown in the specimen V 12172.4, somewhat similar to the recent catostomid *Myxocyprinus* (Lo and Wu, 1979, fig. 1). The frontal is broad anteriorly and narrow posteriorly, the hinder part of which is as wide as parietal, the length of the bone is twice that of the parietal, and it has a much enlarged and roughly semicircle-shaped postorbital process. Dorsally the frontals bear a number of radial ridges on the posterior parts of the bones. The parietal is large, much longer than wide and roughly rectangular, with straight suture with its counterpart. The dermosphenotic is rather large, not overlapped by the frontal, and roughly arc-shaped from its dorsal view, it possesses an expanded anterior end, constituting posterodorsal rim of the orbit. The dermopterotic only has its anterior part preserved. The supraoccipital has a short anteromedial process, inserting between the hinder parts of the parietals. It bears a long, rod-like medial supraoccipital ridge. The epiotic is broken, bordered anteriorly by the parietal, and medially by the supraoccipital.

The circumorbital bones (Fig. 1, 3, 5A) consist of four infraorbitals, a dermosphenotic, a lachrymal and one supraorbital. The lachrymal appears to be large, convex anteriorly and slightly concave posteriorly. Infraorbitals 1 and 2 are relatively small and roughly quadrangular. Infraorbital 3 is the largest, much deeper than wide, forming the posteroventral margin of the orbit. Infraorbital 4 is comparatively large, slightly deeper than wide, nearly quadrangular. Supraorbital is small and crescent-shaped, attached to the supraorbital notch.

The mouth is small, terminal and edentulous. The oral border of the upper jaw is formed of a large premaxilla, excluding maxilla from the gape (V 12172.5A, Fig. 3), as in other cyprinids. The ascending process of premaxilla is short, pointed; its lateral branch is well-developed. Dorsally, the maxilla bears two processes on the anterior and posterior parts of the bone respectively. The mandible is robust, consisting of a large dentary and small anguloarticular, the former bears a low coronoid process, as in *Myxocyprinus asiaticus* (Lo and Wu, 1979, fig. 3). Pharyngeal teeth are somewhat compressed conical, with slightly bent tips (V 12172.6).

The operculum is very large, its height is about 1.3 times its width, the anterior border is nearly straight, the anteroventral corner is truncated, the posterior border is rounded, the superior border is slightly concave, with a very strong and handle-like anterodorsal articular process, and the posterodorsal process is not marked. The suboperculum is considerably smaller than the operculum and roughly elongate-triangular, with a relatively long anterodorsal process. The preoperculum is comparatively broad and sickle-shaped, its horizontal limb is slightly shorter than the vertical one. The inner angle between the two limbs of the preoperculum is much larger than right angle. The preopercular sensory canal runs down the middle of the bone. The interoperculum is small and with higher angular posterior portion. The branchiostegal rays are comparatively broad and three in number.

Excluding the vertebrae forming the Weberian apparatus, there are about 35 vertebrae, of which 14 are precaudal and 21 are caudal. The vertebral centrum is longer than deep, and markedly constricted at the middle. Each centrum bears a horizontal ridge on its lateral surface, bound above and below by a fossa. The fourth trunk vertebra bears a particularly strong parapophysis, indicating the presence of Weberian apparatus. The fifth to eighteenth vertebrae bear ribs, of which the anterior five pairs are comparatively strong, all nearly reaching the ventral border. The neural and haemal spines are long, slender, and posteriorly directed. Long, slender intermuscular bones are numerous, including epineurals and epipleurals, the former arise from the bases of almost all neural arches, the latter arise from the bases of the haemal arches. Anterior to the dorsal fin is a series of mid-dorsal supraneurals, each one occupying the space

between two neural spines. The caudal skeleton is of the cyprinid and catostomid pattern. It consists of a compound ural centrum formed by fusion of the pu1, u_1 and u_2, with a short neural arch, and fused with the pleurostyle, one pair of free uroneurals, a parhypural, six hypurals and one epural. The compound ural centrum with the pleurostyle and the second hypural are fused to form a V-shaped structure, in the notch of which third hypural is tightly articulated. The rest of the hypurals are attached to the pleurostyle. The parhypural and first hypural are fused proximally, but are not fused with compound ural centrum. The neural arch of the first preural centrum is short and pointed. The single epural is long and slender, and is parallel to the pleurostyle. The single uroneural (un) is probably present on each side of the posterior end of the pleurostyle.

The supracleithrum is comparatively strong and slightly curved, with slightly rounded dorsal and ventral ends. The cleithrum is very strong and spoon-shaped, with a pointed vertical limb and anteroventral one; its posteroventral edge is frequently notched. The scapula is an irregular polygonal bone, with a large scapular foramen which is located near the anterodorsal edge of the bone. The coracoid is well developed, and roughly elongate-triangular in shape.

The pectoral fin is large, consisting of one unbranched and thirteen to fourteen branched fin-rays, extending posteriorly about two-thirds the distance to pelvic fin origin. It is supported by about fourteen elongate-triangular pterygiophores. Beneath these fin-supports there are about four large radials.

The pelvic fin is very small, sitting in the midway between the pectoral and anal fins, and composed of one unbranched and seven to eight branched fin-rays. It is supported by a large forked pelvic bone, as in the cyprinids.

The dorsal fin is short-based; its origin is slightly behind that of the pelvic fin. It consists of three unbranched and eight to nine branched fin-rays, which are supported by nine to ten pterygiophores, the first one of them is very expanded ventrally, the others are pointed ventrally and expanded at their dorsal ends. The anal fin is far away from the caudal fin, containing three unbranched and seven to eight branched rays, which are supported by about ten pterygiophores, the first one of them is somewhat expanded anterodorsally, the others are roughly elongate-triangular. The caudal fin is deeply forked, consisting of 17 branched rays and one unbranched ray above and below the fin.

Comparison and discussion The new genus *Tianshanicus* shares most of cyprinid characters, including: mouth toothless; upper jaw margin formed by premaxilla alone; pharyngeal teeth of leuciscine type; paired fins with a single unbranched ray respectively; pelvics abdominal; single dorsal fin, almost opposed to pelvic; and caudal fin deeply forked. *Tianshanicus* is assigned to the subfamily Leuciscinae because it shows typical characters of the subfamily, containing: anal fin with more than seven branched rays; body elongate-fusiform; mouth terminal; dorsal and anal fins without osseous spine, origin of the dorsal fin slightly behind that of the pelvic.

In general features, *Tianshanicus* resembles *Palaeoleuciscus*, *Palaeorutilus* and *Plesioleuciscus*, but distinguished from the latter three genera by the characters of the skull roof, opercular apparatus and mandible. In the latter three genera the frontal is narrow anteriorly and broad posteriorly, and with a smaller postorbital process; the parietal is small and square, the dermosphenotic is very small; the infraorbital series is weak and narrow; the dentary bears a higher coronoid process; the upper part of the opercular is narrower than its lower part, the preopercular has a shorter vertical limb than in the new genus. Besides, in *Palaeoleuciscus* the maxilla is arched, the opercular is almost trapezoid, with a very oblique lower margin, the hypurals are five in number, and the vertebrae are 32 to 35 in number. In *Palaeorutilus* the opercular is roughly trapezoid, with a very oblique lower side, the vertical limb of the preopercular is wider and shorter than the horizontal one, and the hypurals are five in number. In *Plesioleuciscus* the

opercular is a nearly trapezoid, with a rather oblique lower side, the hypurals are four in number, and vertebrae are 34 in number.

Tianshanicus liui and an isolated scale of the family Osteoglossidae(?) occur in the Anjihaihe Formation (lacustrine deposits) of the Paleogene in the southern margin of the Junggar (Dzungar) Basin in northern Xinjiang. The formation has already yielded *Amia* sp. (Amiidae) and *Siluridarum* sp. (Siluroidei), but the age of the formation is disputed. Jiang Xian-ting (citation from Li, 1984) suggested that the age of the formation as the Oligocene on the basis of the remains of the Ostracoda. Li (1984) suggested that the age as late Eocene-Oligocene on stratigraphical and paleontological evidences. However, according to the fossil fishes, the author considers that its age is most probably late Eocene. *Tianshanicus* closely resembles *Palaeoleuciscus* from the Oligocene-Miocene and *Palaeorutilus* from the Oligocene of the western Europe (Czechoslovakia and Germany etc.), but it possesses a number of primitive characters, and is more primitive than the latter two genera. A large cycloidal scale of the Osteoglossidae (?) ornamented with characteristic reticulate structure closely resembles those of *Sinoglossus* from the late Eocene of Sichuan Basin, southern China, and those of *Musperia* (Osteoglossidae) from the late Eocene of central Sumatra. The remains of the genus *Amia* and Siluroidei have been commonly found from the Paleogene of Asia and North America, e. g. the middle Eocene of Bohai Gulf region, China, the Eocene-Oligocene of East Kazakstan, and Green River Formation (middle Eocene) of North America. The genus *Amia* has also been found from the late Paleocene-early Miocene of the western Europe (France, Belgium, and Czechoslovakia). Besides fossil fishes, some other vertebrate fossils have been found in the same formation of different localities. These include mammalian *Bothriodon* sp. (late Eocene), and reptilian *Dzungarisuchus manasensis* (late Eocene) and *Amyda* sp. Based on the nature of the fauna, the age of the Anjihaihe Formation is considered as the late Eocene.

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